

What is claimed is:

A method for fabricating a damascene interconnect structure having one or more air trenches and a plurality of spaced-apart metal lines comprising:

- 5 (a) fabricating the damascene structure to a via level through a processing step prior to forming contact vias;
- (b) etching one or more air trenches into the damascene structure so that the air trenches are positioned between selected metal lines; and
- (c) depositing a sealing layer over the damascene structure having air trenches to seal the air trenches.

2. The method of claim 1, wherein step (a) includes:

- depositing a first dielectric layer;
- depositing a first capping layer over the first dielectric layer;
- depositing a second capping layer over the first capping layer;
- depositing a second dielectric layer over the second capping layer; and
- depositing a third capping layer over the second dielectric layer.

3. The method of claim 2, further including:

etching an air trench in the first and second dielectric layers, and the first, second and third capping layers.

4. The method of claim 1, further including:

- 20 forming a via in the sealing layer and the damascene structure;
- forming a metal plug in the via;
- forming a trench over the sealing layer; and
- forming a conductive layer in the trench.

5. The method of claim 1, further including:

- 25 depositing an etch stop layer over the sealing layer;

forming a via in the etch stop layer, the sealing layer and the damascene structure;

5 forming a metal plug in the via;

forming a trench over the etch stop layer; and

forming a conductive layer in the trench.

6. The method of claim 1, further including:

forming a via in the sealing layer;

forming a trench over the sealing layer;

forming a via in the damascene structure; and

forming a conductive layer in the trench.

7. The method of claim 1, further including:

forming a trench over the sealing layer;

forming a via in the sealing layer and the damascene structure; and

forming a conductive layer in the trench.

8. The method of claim 1, further including:

forming a via in the sealing layer and the damascene structure;

forming a trench over the sealing layer; and

forming a conductive layer in the trench.

9. An integrated circuit structure, comprising:

20 a substrate;

a first dielectric layer deposited over the substrate;

25 a first conductive material spaced apart to form conductive lines in the first dielectric layer;

a second dielectric layer deposited over the first dielectric layer;

an air trench pattern having one or more air trenches, with at least one air trench positioned between a pair of adjacent conductive lines and extending through the first and second dielectric layers; and

a sealing layer deposited over the second dielectric layer to seal the air trenches.

10. The structure of claim 9, further including a first capping layer positioned between the first and second dielectric layers.

5 11. The structure of claim 10, further including a second capping layer positioned between the first capping layer and the second dielectric layer.

12. The structure of claim 11, further including a third capping layer positioned between the second dielectric layer and the sealing layer.

13. The structure of claim 9, further including an etch stop layer deposited over the sealing layer.

14. The structure of claim 12, wherein the first and second capping layers are made of the same material, and the third capping layer is made of a material that is different from the material of the first and second capping layers.

15 15. An integrated circuit structure, comprising:  
a substrate;  
a first dielectric layer deposited over the substrate;  
a first layer of conductive material spaced apart to form conductive lines in the first dielectric layer;  
a second dielectric layer deposited over the first dielectric layer;  
20 a sealing layer deposited over the second dielectric layer;  
a second layer of conductive material deposited above the sealing layer;  
an air trench pattern having one or more air trenches, with at least one air trench positioned between the first and second layers of conductive material and extending through the first and second dielectric layers; and  
25 wherein the sealing layer is deposited to seal the air trenches.

16. The structure of claim 15, further including a first capping layer positioned between the first and second dielectric layers.

17. The structure of claim 16, further including a second capping layer positioned between the first capping layer and the second dielectric layer.

5 18. The structure of claim 17, further including a third capping layer positioned between the second dielectric layer and the sealing layer.

19. The structure of claim 15, further including an etch stop layer deposited over the sealing layer.

20. The structure of claim 18, wherein the first and second capping layers are made of the same material, and the third capping layer is made of a material that is different from the material of the first and second capping layers.